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5

SOME TREMATODES IN MYTILUS.

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## SOME TREMATODES IN MYTILUS.

By MARIE V. LEBOUR.

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The Trematodes form a group of parasitic flatworms having a thick chitinous cuticle without cilia in the adult, and bearing two suckers, one in the mouth region and one near the posterior end or in the centre, on the ventral surface. From these suckers the group takes its name, Trematode being from the Greek word meaning "pierced with holes." There are ectoparasitic Trematodes, which have no metamorphosis, and endoparasitic Trematodes, which have a metamorphosis in their life history. It is entirely with the latter that I shall have to do here. These form the order Malacotylea or Distomea. The life history is complicated, the fertilised egg giving rise to a larva which, to complete the cycle, enters another host, the "intermediate" host. In this host it generally gives rise asexually to a second form, and frequently these again to a third form, which enters a final host, from which the adult sexual worm is developed. The adults live in vertebrates, generally in the alimentary canal or its outgrowths, and a mollusk is always the first intermediate host and frequently the second host in which the larva encysts, but almost any other invertebrate may be the second intermediate host.

It was a great pleasure to me to discover in our local mussels, the common *Mytilus edulis*, three distinct species of these younger stages of Trematodes. The first of these is a well-known one, although apparently it has never before

been recorded for the Northumberland coast. This is the Pearl Trematode, which Dr. Lyster Jameson, in his recent researches, has proved to be the cause of the pearl in the mussel.<sup>1</sup> The second is the same worm that I found last year encysted in the foot of the cockle, *Cardium edule*, and published a short note on in the *Northumberland Fisheries Report* for 1904. It is apparently a new species, and a description of it has just been published by Mr. William Nicoll, M.A., B.Sc., of the Gatley Marine Laboratory, St. Andrews.<sup>2</sup> The third, from the mussel's liver, is possibly new. I have not as yet been able to find out the adult.

Before describing these worms, perhaps it would be as well to go over briefly the life history of a species which has been completely worked out, and for this purpose I cannot do better than take *Distoma hepatica*, the "liver fluke," although, perhaps, almost a too well-known example.

*Distoma hepatica* is the cause of "sheep rot" and occurs in the gall bladder and bile ducts (and their capillaries) of the sheep. The eggs pass out of the sheep, and those that get into water develop into free swimming embryos covered with cilia, having two eyes, a small enteron and a mouth. If this embryo comes across a small freshwater snail, *Limnaea truncatula*, it bores its way into its liver; here it pauses and undergoes degeneration, losing its enteron and its cilia. It is now known as a sporocyst. The sporocyst is an elongated sac-like body full of balls of cells, the so-called "egg balls." These give rise to a different form called a redia, which is also elongated, but has a pharynx and an enteron. The redia breaks through the wall of the sporocyst, which closes up again. Inside the redia are formed more egg balls and some of these may develop into another form, the cercaria, which is broad and bears a tail. This escapes from the redia and finally gets out of the snail and swims about in the water by aid of its tail. It possesses all the organs of a young fluke in a rudimentary state, even the genital organs. It bears a ventral sucker and by its means

<sup>1</sup> *Proc. Zool. Soc.*, London, 1902, vol. i., page 140.

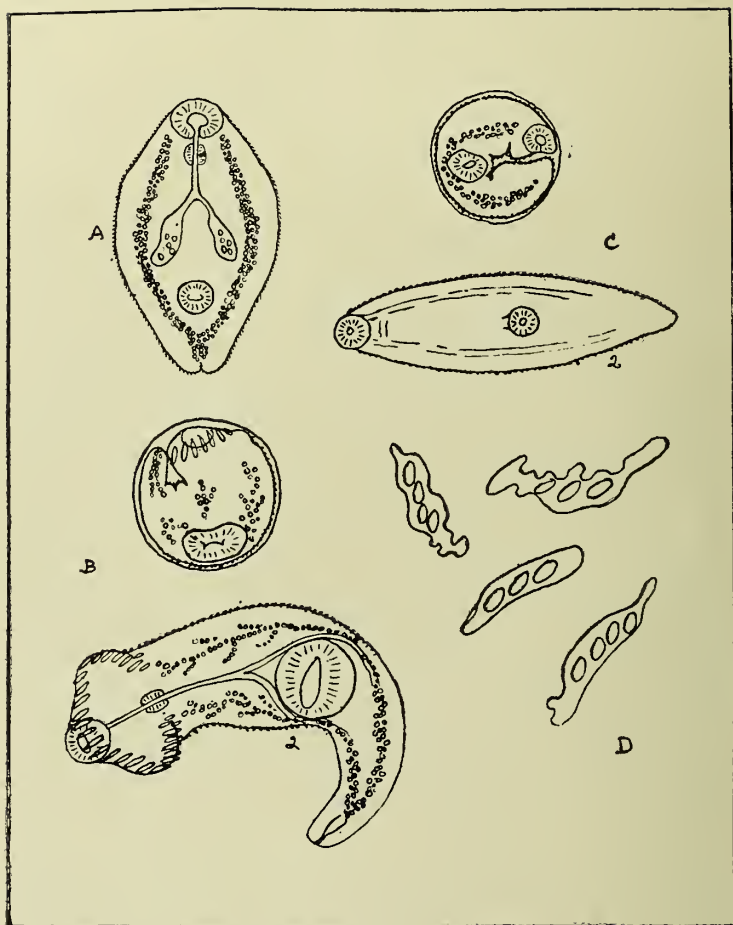
<sup>2</sup> *Ann. and Mag. Nat. Hist.*, Jan., 1906.

attaches itself to a blade of grass. It then secretes a mucous, which hardens round it and forms a cyst. Curled up in its cyst it waits, and should a sheep happen to eat it, the cyst is dissolved in the stomach and the worm emerges, having lost its tail during the resting stage. It makes its way into the bile duct, grows and reproduces, and so the life history begins over again.

This is practically what happens, of course, with various modifications, in the whole order. The redia generation may be omitted and the sporocysts may form a second generation of sporocysts, from which cercariae arise. The sporocysts and rediae are always parasitic in some mollusk, but the free swimming or crawling cercaria (for all do not possess tails) may go into almost any invertebrate or may just swim about in the water before being swallowed by some vertebrate.

The worms I have come across in the mussels (all from Budle Bay) are all in the cercaria stage, or rather two of them are encysted. The first of these is the Trematode that causes the mussel pearls, *Leucithodendrium* (*Brachycoelium*) *somateriae*, closely allied to Distoma. It is a very well-known fact that pearls occur in the mussels of our coasts, and although many conjectures were brought forward as to a worm being the cause of these, it was only in 1902 that Dr. Jameson definitely proved the cause to be the cercaria of this Trematode (*op. cit.*).

There are not many pearls in the Budle mussels, and these are not fine as a rule. I have, however, discovered this cercaria, which agrees in every respect with Jameson's figures, on the mantle of some of these pearl-bearing mussels. Not more than one or two on each specimen were found, and these only occasionally. Jameson found it abundantly at Piel, on the Lancashire coast; he describes it as visible to the naked eye as small yellow spots, about  $\frac{1}{2}$  mm. in diameter, on the mantle, the yellow colour being due to the food material in the intestine. When magnified considerably, it is seen to be of an oval form, with no tail, much the same shape as the adult worm which is found in the



## EXPLANATION OF PLATE.

- a* Cercaria of Pearl Trematode from Mussel—l. 0.5 mm.  
*b* (1) Encysted Cercaria from foot of Mussel—diam. 0.21 mm.  
 (2) Cercaria pressed out of Cyst—l. 0.7 mm.  
*c* (1) Encysted Cercaria from liver of Mussel.  
 (2) Cercaria pressed out of Cyst—l. 0.46 mm.  
*d* Sporocysts from *Cardium edule*.



Eider Duck and Scoter (see Plate, Fig. A). It is very active and contractile and its body is covered with small sharp spines. There is a large oral sucker, and a ventral sucker which is somewhat smaller. The digestive canal is bilobed and full of yellow food material. The excretory organs are most conspicuous, consisting of granular masses each side, which unite posteriorly and open by a pore. The size of the cercaria is about 0·5 to 0·7 mm. It appears to burrow into the connective tissue of the mantle, and when once settled down is, according to Jameson, surrounded by an epithelial sac formed round it by the mantle of the mussel. As he says, "this epithelium appears to arise quite independently of the outer epidermis, and is no doubt due to a specific stimulation on the part of the parasite." This epithelial sac then secretes the pearl, layer upon layer. The worm may escape from the sac or may die inside the pearl. Remains of dead cercariæ have been found to be the nuclei of some pearls. Professor Herdman thinks the formation of the epithelial sac can only be explained by the worm carrying in with it one or two epithelial cells from the outside, and Giard supports this view.

Jameson found the previous host of this cercaria in France to be *Tapes decussata*, in which he found sporocysts full of the cercariæ. At Piel, he found them in the cockle, *Cardium edule*, near the anterior adductor muscle, and I discovered them also in the Budle cockles, Mr. Nicoll (*op. cit.*) describes it as living in a mass of sporocysts just above the liver in the cockle at St. Andrews, and since reading his paper, I have found them abundantly in this part of the cockle at Budle. Here, then, the cockle is evidently the previous host of the Pearl Trematode. The Scoter, *Edemia nigra*, L., is the final host, and it feeds much on mussels at Piel. The same adult worm was originally described from the Eider Duck, *Somateria mollissima*, L. Both birds are to be found near Budle; the Eider Duck is a resident, breeding on the Farnes and Holy Island, which are the only local breeding places of this species. The Scoter is a not uncommon winter visitant. Either of these

birds may contain the adult worms. One peculiar feature of this cercaria, according to Jameson, is that it is never encysted; apparently the resting stage in the mussel suffices.

The second species in the Budle mussels is an encysted form living in the foot of the animal. This is the same that I found in the cockle but occurs more frequently in the mussel; every specimen, so far examined, contains them, and they were only in about ten per cent. of the cockles. This worm has just been fully described by Mr. Nicoll (*op. cit.*).<sup>1</sup> It cannot be seen from the outside in the mussel, whereas the tubercles found in the cockle's foot are visible from the outside. They do not appear to hurt either animal, their organs being quite healthy. There are many cysts in each foot and by gentle pressure the worm can be squeezed out (see Plate, Fig. B, 1 and 2). The body is about 0.7 mm. long and is covered, except at the posterior end, with sharp spines. The head, which is broadly heart shaped, is surrounded by twenty-nine long spines. There is a large oral sucker, leading by two thick lips into a narrow intestine, which divides into two just in front of the ventral sucker, which is much larger than the oral. Down the sides run two branched excretory organs, joining posteriorly and running into a small excretory sac opening at the posterior end by a pore. Mr. Nicoll has found the adult worm in the Oyster Catcher, *Hamatopus ostralegus*. He describes it as being very similar to the encysted worm, only longer. I might mention that I have also found this worm in cockles from Piel in Lancashire and from Loch Ryan in Galloway, also in the foot of *Mya arenaria* and *Macoma balthica*, and Mr. Nicoll has found it in the foot of *Macra stultorum*.<sup>2</sup>

Before going on to the third and last species, I should like to mention another form once found in the cockles (see

<sup>1</sup> Since writing this, another paper, by Mr. Nicoll, has appeared, describing this worm under the name of *Echinostomum secundum*, *sp. n.*, from the Herring Gull and the Oyster Catcher.—(*Ann. and Mag. Nat. Hist.*, June, 1906, page 513).

<sup>2</sup> Since writing this I have discovered what I believe to be the rediæ and tailed cercariæ of this worm in the liver of the common periwinkle, *Littorina littorea* (see *Northumberland Fisheries Report* for 1905).



Plate, Fig. D). It occurred in great numbers round the liver as very contractile sporocysts with no eyes and containing three or four oval bodies in each. They were now long, now short and round, sometimes appeared to have a tail, sometimes not. They were very transparent and no suckers could be made out. I mention these, as they may be found to be connected with one of the forms in the mussel.<sup>3</sup>

The third species occurs in the liver of the mussels at Budle. It is also encysted, the cysts occurring in between the lobes of the liver. I can see very little structure in it (see Plate, Fig. C). It occurs sparingly generally, but in one specimen it was abundant, the liver was a much darker colour and the animal did not look healthy, its reproductive organs not growing properly.

Altogether it seemed to have a deteriorating effect on the mussel. Great care must be taken in pressing the worm out of its cyst. It is elongated, its body covered with small spines, and it has an oral sucker larger than the ventral, which is slightly behind the centre. In fresh specimens the granular excretory organs are clearly visible down the sides, but these granules disappear when the worm is dead. Two very faint canals can then be made out down the sides, which may be the excretory organs devoid of the granules.

I know nothing about any of the other stages of this worm, but hope to investigate the matter more thoroughly and examine several sea birds for the adult. Birds have an important connexion with Trematodes, the Pearl Trematode living in the Eider Duck and Scoter and that form from the foot of the mussel and cockle living in the Oyster Catcher. Mr. Walton, of Stocksfield, has kindly given me a list of the birds which feed on mussels. He says, "Of course there are many other birds that will eat mussels, especially during the autumn and winter seasons, as the Golden Plover, *Charadrius pluvialis*, which is very fond of the fry of mussels,

<sup>3</sup> This and the following species are described by me in the *Northumberland Fisheries Report* for 1905.

also the Hooded Crow, *Corvus cornix*, which is as fond of mussels as a boy is of nuts." The following is the list:—

Common Scoter	...	...	...	<i>Edemia nigra.</i>
Velvet Scoter	...	...	...	<i>O. fusca.</i>
Common Shelduck	...	...	...	<i>Tadorna cornuta.</i>
Garganey	...	...	...	<i>Querquedula circia.</i>
Common Pochard	...	...	...	<i>Fuligula ferina</i>
Tufted Duck	...	...	...	<i>F. cristata.</i>
Golden Eye	...	...	...	<i>Clangula glaucion.</i>
Scaup Duck	...	...	...	<i>Fuligula marila.</i>
Eider Duck	...	...	...	<i>Somateria mollissima.</i>
Common Heron	...	...	...	<i>Ardea cinerea.</i>
Turnstone	...	...	...	<i>Streptilas interpres.</i>
Oyster Catcher	...	...	...	<i>Hamatopus ostralegus.</i>
Common Gull	...	...	...	<i>Larus canis.</i>
Herring Gull	...	...	...	<i>L. argentatus.</i>
Greater Black-backed Gull	...	...	...	<i>L. marinus.</i>
Kittiwake Gull	...	...	...	<i>Rissa tridactyla.</i>

Of these, the Shelduck, Tufted Duck, Eider Duck, Heron, Oyster Catcher, Common Gull, Herring Gull, Greater Black-backed Gull and Kittiwake are residents. The Shelduck is not common, but breeds in rabbit holes on the links between Bamburgh and Holy Island. The Tufted Duck is not uncommon in the winter, has bred at Wallington and has been seen on Gosforth Lake. The Eider Duck breeds on the Farnes and Holy Island and is fairly abundant, as is also the Oyster Catcher, which breeds in the same islands. The Heron is common. There are heronries at Chillingham, Harbottle and Redewater, also Herons breed regularly in Dipton Woods and they are often seen by the river between Corbridge and Stocksfield. The Common Gull and the Greater Black-backed Gull are not uncommon, but do not breed in the district. The Herring Gull is common and breeds on the Farnes; also the Kittiwakes breed on the Pinnacles, but the greater number migrate. Most of them come from the Bass Rock, which is a great breeding place for them.

It seems likely that one of these common residents will be found to be the final host of this worm; at any rate, the subject is well worth investigation, as very little has been done as yet on the Northumbrian Trematodes.